# 4.—DESCRIPTION AND LIFE-HISTORY OF A NEW WESTERN AUSTRALIAN PSYLLID.*

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CONTENTS.



(with two plates.)

## I. INTRODUCTION.

Most of our knowledge of the Australian Psyllidae is due to the work of W. W. Froggatt ([3]), published in the years 1900 to 1903. His revision included 73 species, of which 64 were new. All were from the eastern parts of Australia, including Tasmania. The same author described another species in 1923 ([6]).

Psyllidae are fairly common in Western Australia, but until a systematic revision of the family is carried out, it is unlikely that much useful work on the local forms will be possible. The family includes at present about 150 genera, many of which were established without reference to any general scheme of classification for the family; and a good deal of the literature is not available to Australian workers. However, there are among the Australian forms a few well-defined genera to which species may be referred without fear of confusion.

One such genus is *Spondyliaspis*, to which belongs the species about to be described.

## II. SYSTEMATICS.

According to Froggatt ([3]), who gives a full definition of the genus, it was established in 1879 by Signoret and later redefined by Schwarz (1896). In the system used by Froggatt, *Spondyliaspis* was placed in the subfamily Aphalarinae, but in Crawford's system ([5]) this genus falls into the Triozinae. At present it includes five species, all from the eastern Australian region.

The new species agrees with the definition of *Spondyliaspis* in almost every particular, and certainly in all of the chief points. Of these may be mentioned the long cylindrical face lobes (genal cones), the flattened surface

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of the head, the dilated apex of the posterior tibia with a strong mucro at the outer angle, the enlargement of the first segment of the posterior tarsus into a cushion-like pad, and the venational characters—although Crawford considers that venation is of little value in the classification of the family.

In the following description the measurements refer to the type specimens only, and their exact values are of no specific significance.

## Genus **SPONDYLIASPIS** Signoret (1879)

re-defined Schwarz (1896)

**Spondyliaspis occidentalis** sp. nov.

*Adult Female.*

Length body 2·55 mm. ; length forewing 2·68 mm.

Colour : chiefly yellow and brown. Head dark brown ; vertex yellowish brown except near margins, median suture and foveal depressions ; compound eyes reddish brown ; genal cones pink ; antennae pink at the base, grading to dark brown towards apex. Thorax mostly brown above, grading to yellow* in places ; sides yellow* and brown ; ventral surface and legs pale yellow, except brown mesosternum ; forewings hyaline with veins and margins brown. Abdomen bright greenish yellow* dorsally, with five transverse segmental brown bands which are narrower near the median line.

Head (Pl. 1, fig. B) flattened above, wider than prothorax but narrower than mesothorax ; vertex minutely punctate, much wider than long, anterior margin on each side angulated to form a projection just internal to base of antenna, foveal depressions (fd) and median suture well-marked, posterior margin concave ; genal cones (gc) projecting antero-ventrally, almost as long as vertex, touching near base, tapering distally and obtusely rounded at apex, with a tuft of subapical setae projecting from latero-ventral surface ; length of the 10-segmented antennae nearly one and one-half times as great as width of head.

Thorax not arched, minutely punctate ; pronotum (pn) nearly five times as wide as long ; praescutum (dorsulum) (ps) passing under pronotum in front, visible part somewhat longer than pronotum. Forewings (Pl. 1, fig. A) hyaline, minutely setose, three times as long as wide, apex acutely rounded ; subcostal vein distinct from margin ; hyaline pterostigmatic area before R1, which extends close to apex before fusing with costal margin ; Rs meeting margin just anterior to apex ; stem M+Cu longer than stem of R1; marginal cells fairly large, subequal in area ; vein 1A represented by a clear line devoid of setulae ; 2A strong. Hindwing with veins Rs, M, Cu1, Cu2, 1A and 2A faintly indicated. Hind tibia (Pl. I, fig. E) short and stout, outer angle of apex with a process bearing two black spines of unequal size, inner margin with a single black spine, and proximally to this a further black spine situated subapically on dorsal surface, also two large rounded processes on dorsal side of apex ; proximal segment of hind tarsus expanded, padlike, concave below ventral margins with a row of stout setae, outer margin of apex with an obtuse black spine ventrally.

Genitalia (Pl. I, fig. C) : dorsal valves (dv) united to form a thickened hood overhanging the shorter and rounded ventral valves (vv) ; ovipositor sheath with a pair of lateral protrusible lobes (l) projecting posteriorly about as far as the dorsal valves.

* This yellow colouration is often tinged with, or wholly replaced by, a vivid green.

*Male.*

Length body 2·23 mm. ; length forewing 2·03 mm., Genal cones, being somewhat narrower than in female, not meeting at base.

Genitalia (Pl. I, fig. D) : forceps (f) curved backwards, tapering bluntly at base and at apex, subequal in length to genital segment and to anal valve (dv), which is sublinear posteriorly and convex anteriorly.

Other details as described for female.

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The lerp scale (Pl. I, fig. F) is a circular dome of white sugary material, rugose, and composed of strands laid together unevenly. Usually there are a few long contorted filaments projecting from the surface of the scale.

Host : *Eucalyptus gomphocephala.*

Locality : Perth, Western Australia. (Four colonies in the grounds of the Department of Biology, University, Crawley.)

## III. IMMATURE STAGES—EXTERNAL MORPHOLOGY AND DEVELOPMENT.

The *egg* is subovate, with a smooth chorion, and is yellow in colour. At one end is a short peduncle by which the egg is attached to the leaf. Its length is about one-third mm., while the peduncle is about one-fifth as long.

The general features common to *nymphs* of all instars are as follows. (See Pl. II). The body is flattened dorsoventrally. The head (except in the fifth instar) is not demarcated from the rest of the body by a suture ; it bears a pair of antennae and a pair of rudimentary or well-developed compound eyes ; ventrally there is an oral cone from which may be protruded the usual long filamentous maxillary and mandibular setae. The thorax bears dorsolaterally two pairs of wing pads. The three pairs of legs are 3-segmented in all except the fifth instar, where they are 4-segmented ; the extremity of each leg is provided dorsally with two long curved and clavate setae, and ventrally with a process bearing two down-curved claws, each claw being provided ventrally near the base with a stout upcurved seta. The tapering abdomen is more or less distinctly demarcated into seven segments, each with a pair of dorsal sclerites near the posterior border and a corresponding pair ventrally ; it bears one or more pairs of wax glands postero-laterally. Within the abdomen may be seen the mycetomes, appearing as a pair of yellow bodies incompletely divided into three or four segments (the outlines of the mycetomes are stippled in the diagrams).

The body-lengths of typical individual nymphs of successive instars are indicated in the illustrations on Plate II. But the body-length in each instar is very variable, owing chiefly to the fact that the nymphs undergo a gradual increase in size during the instar. This applies also to the other dimensions such as head-width and length of wing-pads. This presents a marked contrast to the condition found in the related family Aleyrodidae, in which the larvae do not increase in length or breadth except at the time of moulting.

There is an obvious reason for this difference : in the larvae of Aleyrodidae the dorsal cuticle is comparatively tough and inextensible, while in the Psyllidae (as in the Aphididae), the cuticle is thin and much less resistant. This allows of a gradual increase in size, instead of several spasmodic increases as observed in Aleyrodidae.

As may be seen from Plate II (fig. F, etc.) the proportions of various parts of the body change gradually throughout the nymphal development. Apart from this, there are a number of more particular characters by which the five instars may be distinguished one from another :—

*First Instar* (Pl. II, fig. A) :

Antennae 3-segmented, with a sensory pit on the posterior border of the penultimate segment. Eyes each consisting of a group of a few ommatidia (typically 4). Wing pads incipient*, projecting laterally from the thorax. Abdomen scarcely if at all wider than thorax (contrast later instars). A single pair of wax glands placed dorso-laterally on the penultimate (apparent 6th) abdominal segment.

*Second Instar* (Pl. II, fig. B) :

Antennae 4-segmented with sensory pit on the posterior border of the penultimate segment. Eyes, as in first instar, each with (typically) 4 ommatidia. Wing pads clearly apparent. Two pairs wax glands (abdominal segments 5 and 6).

*Third Instar* (Pl. II, fig. C) :

Antennae 5-segmented. The ommatidia of previous instars projecting beyond the remaining facets of the developing compound eyes. Three pairs wax glands (abdominal segments 4, 5 and 6).

*Fourth Instar* (Pl. II, fig. D) :

Antennae 7-segmented. Compound eyes well developed. Paired groups of wax glands (abdominal segments 4, 5 and 6). Dorsal abdominal sclerites broader antero-posteriorly than in previous instars.

*Fifth Instar* (Pl. II, fig. E) :

Antennae 10-segmented. Compound eyes well developed. Lateral ocelli visible. Epicranial suture developed : sutures bounding pronotum and praescutum visible but not prominent. Wing pads more or less darkly pigmented. Legs 4-segmented owing to the subdivision of the distal segment (tibio-tarsus) of previous instars.

## IV. NOTES ON HABITS AND ECOLOGY.

The whole of the life-history is passed through on the twigs and foliage of the host, usually on low branches or shoots within a few feet of the ground. The life-cycle is completed in a few weeks in the summer. Some nymphs that were kept on floating leaves in the laboratory reached the second instar 6 days after hatching from the egg, while some passed from the second to the fifth instar in 7 days.

*The Eggs :* These occur in groups on both faces of the Eucalyptus leaves, usually near the petiole. There are typically 60 to 80 eggs in one group, but sometimes over 300 have been counted. These large groups probably result from oviposition by more than one female. The females select fairly young and tender leaves on which to lay their eggs, so that the Psyllid colony moves slowly out along the branches, following the development of new shoots and leaves.

* Crawford (5) states that the wing pads become visible after the first moult. But in this species, at least, the projections representing incipient wing pads are visible in the first instar. They appear as lateral outgrowths of the thorax, and retain that appearance during most of the second instar ; it is in the late second or early third instar that they come to point posteriorly, owing to the increasingly rapid growth of the anterior parts of the wing pads as compared with the growth-rate of the posterior parts (Compare figs. A, B and C, Plate II.).

*Nymph and Lerp Scale :* The newly-hatched nymph usually moves from the blade of the leaf to the petiole, where it comes to rest and begins to secrete the test or lerp scale.

The material of the scale is not wax (the wax glands produce only a very sparse secretion), but the sugary " Honey-dew " exuded from the anus. This substance is at first transparent and fluid, but slowly whitens and solidifies. The first strands of secretion are arranged to form a framework shaped like a flattened pyramid. The outer ends of the strands are attached to the plant and arranged roughly in a circle. The inner ends meet near the centre of this circle, but at some distance from the plant surface, so as to form a radiate framework above the insect. The nymph then fills in the gaps with more secretion to form a complete covering under which it rests protected. This final process was observed under a binocular microscope in one instance, when the nymph was seen to be adding the secretion in a continuous spiral string, by moving the anus round the centre of the scale in gradually increasing circles, in an anti-clockwise direction. The time required for the whole process is something less than 24 hours. The above-mentioned radiate framework of the scale is similar to that figured and described by Dobson (²) for *Spondyliaspis eucalypti* (Dobson).

If the scale is removed, the nymph usually moves about the petiole or stem for some time and then settles in a new position. Here it usually secretes a new scale, either immediately or after a period which may be of several days duration.

As the nymph increases in size, additions are made to the edges of the scale and its centre becomes raised further from the plant surface. Exuviae become attached to its walls and incorporated in its structure. The lerp scales occur usually in dense aggregations, as shown in Plate I, fig. F.

The lerp scale is a structure peculiar to certain Australian Psyllidae which live on Eucalypts. It has excited interest in Australia and England for more than a century—as early as 1849, Anderson published a chemical analysis of the lerps of some Victorian Psyllidae (His results were as follows : water 15·0% ; sugar, with a little resinous matter, 49·0% ; gum 5·77% ; starch 4·29% ; inulin 13·80% ; cellulose 12·04% = total 100% + ash residue 1·13%). Froggatt (1900) gave an account of its use as food by the natives and settlers in eastern Australia.

*Comparison with Protected Stages in Related Families :* It may be remarked that the phenomenon of an immature form coming to rest within a protective covering, with concomitant modifications of structure, is a characteristic of the Sternorrhynchous Homoptera, and is to be observed in all four of the families included in that group.

In the Aleyrodidae, the larva becomes stationary soon after emergence from the egg, and the dorsal cuticle becomes toughened, while added protection is provided in many species by the secretion of a dorsal plate of wax ; as development proceeds, the legs and antennae degenerate. In the Coccidae the young larva comes to rest and secretes a scale or a covering of wax, or in some cases lies protected within a gall. In any case, the legs and antennae usually become more or less degenerate. In both these families (excepting female Coccidae) the passage from larva to adult is usually effected by means of a metamorphosis very similar to that found in Holometabolous insects ; this is necessary because of the low grade of structure at which the larval development stops short, and this in turn is partly due to the assumption of a more or less stationary and protected manner of life.

The development of most Aphididae is on the typical Hemimetabolous plan, with a gradual transition from newly-hatched nymph to adult. But some Aphids pass through a phase in which the body is flattened and scale-like and the appendages degenerate (genera *Hormaphis*, *Hamamelistes* and *Cerataphis*: see Pergande (4), and Imms (7)). In these phases the resemblance to Aleyrodid and Coccid scales is both striking and significant.

The mode of development in the Psyllidae is, like that in most Aphididae, typically Hemimetabolous. But here again, as in the other three families, there are forms which come to rest beneath a protective covering—in this case the lerp scale excreted from the anus. In these lerp Psyllids, however, (as exemplified by *S. occidentalis*), the protected life has not yet resulted in any marked modification in the nymphs: the appendages are not degenerate and the body, although flattened, is not unusually so.

It may be suggested, therefore, that the secretion of a lerp scale is a comparatively recent development. Probably its chief advantage is the protection from evaporation which it affords.

*Adults:* The adults, like the nymphs, suck the sap from leaves or young twigs. They copulate frequently and for long periods, the male and female standing end to end with the genitalia firmly interlocked. In spite of their powers of leaping and flight, the insects seldom move far from the tuft of foliage which bears the colony.

*Associated Animals:* *S. occidentalis* resembles many other Homoptera, including a number of Psyllidae, in being associated with ants. At Crawley, the colonies of the Psyllid are invariably found to be attended by numbers of ants of a species very common about Perth. The Writer is indebted to Mr. J. Clark, of the National Museum, Melbourne, who has indentified the ants as *Iridomyrmex discors* Forel, var. *exilior* Forel., with the remark that most of the members of this genus are associated with Homoptera, particularly Psyllids and Coccids. In this case the ants are attracted to both adults and nymphs; also they are often seen nibbling at a lerp scale, though they probably do this in attempting to reach the nymph below, as the writer has never seen them carrying any of the dry lerp material.

It may be noted also that *S. occidentalis* is subject to parasitism by Chalcidoid wasps, whose larvae develop in the Psyllid nymphs and cause them to become greatly distended, with the integument stiff and brown.

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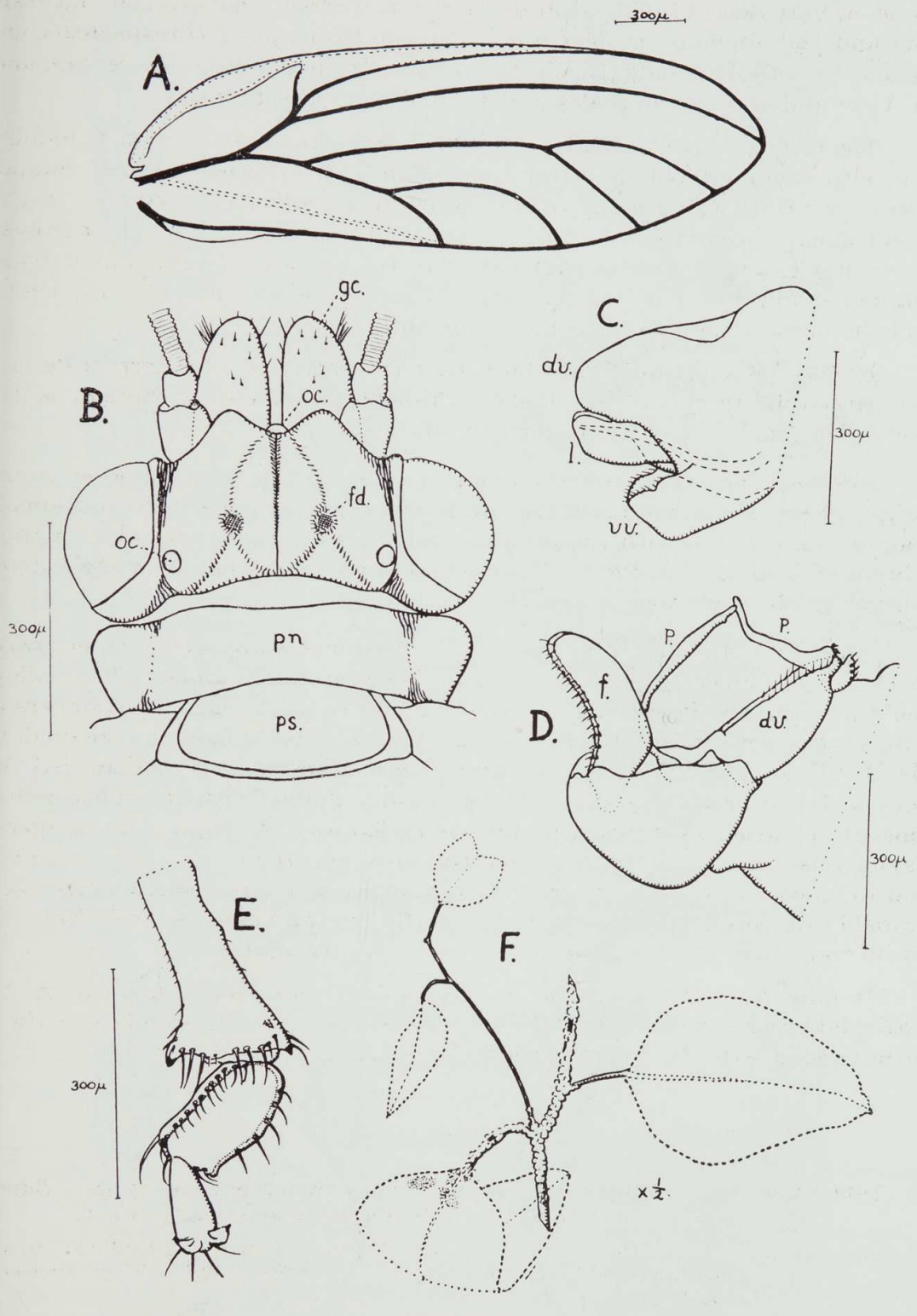


PLATE I.

*Spondyliaspis occidentalis* n. sp.

A., forewing ♀. B. dorsal view of head and part of thorax ♂ (gc, genal cone ; oc, ocellus ; fd, foveal depression ; pn, pronotum ; ps, praescutum). C., lateral view genitalia ♀ (dv, dorsal valves ; l, lobes of ovipositor sheath ; vv, ventral valves). D., lateral view genitalia ♂ (f, forceps ; p, penis ; dv, dorsal valves). E., ventral view of right hind leg ♀, showing tarsus and apex of tibia. F., lerp scales on twig of *Eucalyptus gomphocephala*.

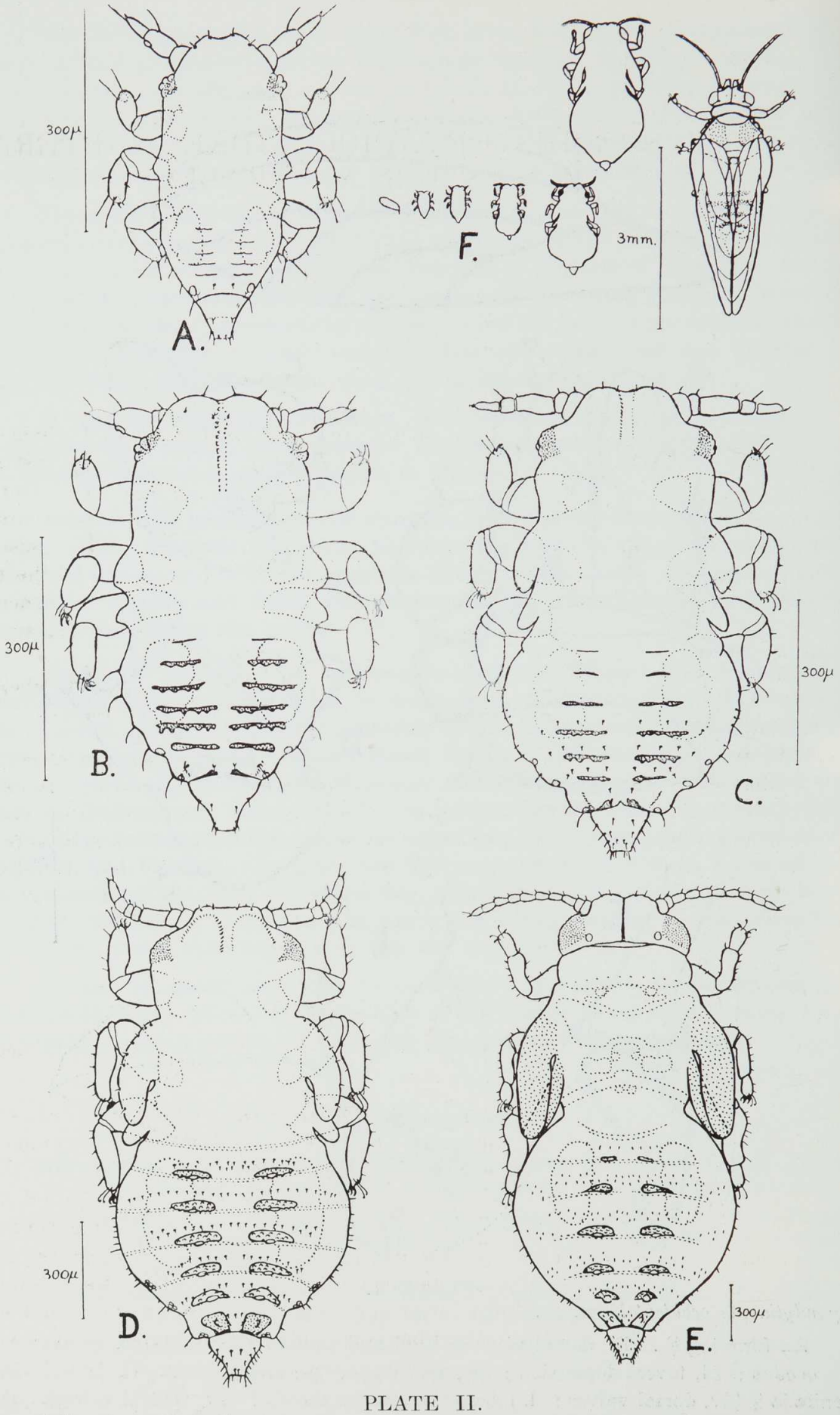


PLATE II.

*Spondyliaspis occidentalis* n. sp.

Dorsal view of nymphs (outlines of mycetomes stippled). A., first instar. B., second instar. C., third instar. D., fourth instar. E., fifth (final) instar. F., outlines of egg, nymphs of instars one to five, and adult ♀, drawn all to the same scale.